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The Best Means of Rapidly Increasing the Outturns of Food Crops by Methods within the Power of the Agricultural Department

Being Notes submitted to the Meeting of the Board of Agriculture in India, Poona, 1917.

Edited, with an Introduction, by

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INTRODUCTION

THE question of the best means of rapidly increasing the outturns of food crops by methods within the power of the Agricultural Department was discussed at the meeting of the Board of Agriculture held at Poona in December 1917. No resolutions on the subject were passed, but the discussion was interesting and the papers submitted by the various provinces contain many suggestions of permanent value. They are now published in this volume in the hope that they may prove suggestive to agricultural workers. They give an indication of what has already been done in the different provinces and throw out suggestions as to measures which could rapidly be adopted with a view to insure a quick increase in foodstuffs. In times of national emergency, such as the present, it is necessary that our Agricultural Departments should be able to meet a sudden demand, and a perusal of this volume will indicate the various methods which can be adopted.

The methods by which the produce of a country can be increased fall into two classes :—

In the first place, the food supply of a country may be increased by substituting food crops for fibre or other non-food crops or by the breaking up of new lands formerly not under cultivation. These, however, are rather administrative questions dependent either upon the arbitrary order of Government that cropping should follow a certain scheme or on the availability of waste lands formerly uncultivated.

The second group of methods which more properly come within the scope of the Agricultural Department are :—

(1) introduction of improved varieties,

(2) manures, and

(3) better cultivation,

and in the papers which appear in this Bulletin the efforts of the various Agricultural Departments along these lines are recorded. It must be remembered that there are considerable

limitations to the use of manures. There are also limitations to intensive cultivation on account of the shortage of cattle, while it is probably dangerous to suggest revolutionary changes in well-established schemes of rotation. Advance along these lines must be gradual and the most hopeful prospect of a rapid development depends on the evolution of improved high yielding varieties of crops such as the Pusa, Punjab and Central Provinces wheats and Bengal, Madras, Central Provinces and Burma paddies, combined with an effective organization for the rapid dissemination and distribution of these improved varieties.

J. MACKENNA,

Agricultural Adviser to the Government of India.

SIMLA :

September 10, 1918.

The best means of rapidly increasing the outturns of food crops by methods within the power of the Agricultural Department.

CHAPTER I.

BENGAL.

(S. MILLIGAN, M.A., B.Sc., *Director of Agriculture.*)

The following are the normal areas under the principal food crops in the province as given in the Season and Crop Reports :—

	Acres.
Winter rice	16,622,500
Aus rice	5,031,500
Boro rice	370,000
Gram	240,000
Wheat	205,000
Barley	140,000
Other food grains	1,730,000

It will be noticed that what is termed the winter rice crop is by far and away the most important. Under this heading are included two different crops :—

(1) the transplanted "aman";
(2) the long-stemmed deep water paddy.

Unfortunately both are returned together, and no separate figures can be given for each variety. A very rough estimate of the ratio between the two may be taken at 5: 3, given 6 million acres under deep water and 10 million acres under transplanted "aman."

The summer or "aus" crop is the next in importance, and then the "boro" or early summer crop which occupies the place of least importance amongst the rices.

The principal *rabi* (winter) crops are wheat, barley and gram.

The *rabi* crop, however, does not approach the *kharif* (monsoon crop) in importance in Bengal, owing to the fact that the great bulk of the land is low-lying and suited for rice only.

The Agricultural Department has confined its investigations mainly to the examination of the varieties of transplanted rice. Owing to the redistribution of the provinces, the Agricultural Station at Dacca now serves Eastern and Western Bengal in place of Eastern Bengal and Assam. This has led to a much greater development of the work as applied to Eastern Bengal. While, therefore, a very thorough examination of the Eastern Bengal rices has been made, it has not been possible to take up similar work in Western Bengal. A very marked success with great economic possibilities has, however, attended the work on transplanted rice of the Botanical Section at Dacca. Examination of the different Eastern Bengal varieties (over 2,000 have been dealt with) has revealed striking differences in yield, and several high yielding strains with other desirable characters have been isolated and multiplied. The pure line *Indrasail* has been finally selected as being the best all round and suited to the largest area. This variety yields a medium quality rice similar to what is commonly consumed by the ryots, and, in addition to being a very high yielder of paddy, yields a high percentage of husked rice. In the opinion of the Economic Botanist, as a result of careful computation, the average yield of *Indrasail* over the varieties commonly grown in the districts of Eastern Bengal is about six maunds per acre. From further tests at the agricultural stations and in the districts a safe estimate of the probable increase due to the substitution of this variety for those of approximately equal quality would be $4\frac{1}{2}$ maunds of paddy or 3 maunds of husked rice per acre. A rough computation of the acreage to which these figures apply in Eastern and Northern Bengal alone is from 4,000,000 to 5,000,000 acres, say, 4,500,000. Thus, if our calculations hold good over this area, an increase of 500,000 tons would follow from the substitution of the *Indrasail* for local varieties.

The work on *aus paddy* has not reached a stage at which definite conclusions as to yield, etc., of the different pure line varieties are possible.

No other crops have been examined as to yield.

The possibilities of increasing the outturn of food crops in the near future through improved varieties is therefore limited to the increased use of high-yielding varieties of *transplanted rice*. The apparent limits

so this are indicated by the figures of 4 to 5 million acres in area under the crop and half a million tons of cleaned rice in outturn. These figures may, however, have to be raised as the variety in question has been tried this year for the first time in Western Bengal and may yet prove a success in that part of the province.

Little can be said of the *present rate of increase* in the area under the new variety. The first outside distribution of seed was made in 1916 at various places along the Dacca-Mymensingh Railway line. The crop proved a success and the variety was at once recognized as being a superior yielder. As a result, seed was in request in the immediate vicinity of the centres of distribution. The apparent conclusion is that, if seed of this variety can be distributed from a sufficiently large number of centres, a very large area may be expected to be under the crop in the succeeding year. Progress, in fact, will bear a close relationship to the number of centres of distribution.

The propagation ratio of transplanted paddy being about 70 : 1, and one maund of paddy seed being sufficient for three acres of land, it follows that the produce from 20,000 maunds of paddy would be sufficient to seed 4,200,000 acres in the succeeding year. The effective distribution of 20,000 maunds of *Indrasail* paddy would thus result in the production of enough seed of the improved variety for almost the total area to which it applies. It remains to find an efficient organization to distribute the seed so as to prevent "overlapping" and to promote the expansion of the area inside definite limits. The present policy of the Department is to make as much use of the village panchayets as possible for this purpose. This agency has this obvious advantage that it covers the district completely and uniformly. We may be therefore sure that a seed distribution through the panchayets will be exhaustive. It will be also possible for the panchayets to distribute the seed uniformly throughout their jurisdiction and to make it clear to growers that this seed is being distributed for the sake of further propagation. The variety, once introduced into the village as a unit, must be left to make its own way by virtue of its qualities. The first object is, therefore, the introduction, into every village where transplanted paddy is grown, of a small quantity of the seed of the improved variety.

Two thousand maunds of the *Indrasail* paddy have been distributed according to the above scheme this year (1917). It is proposed to distribute the remaining 18,000 maunds in the next two seasons as follows :—

6,000 maunds in 1918.
12,000 „ „ 1919.

It is thus hoped that in 1919 the distribution scheme will be completed, and that in the harvest of that year there will be sufficient seed for all requirements methodically distributed throughout Eastern and Northern Bengal. If the variety proves suitable for Western Bengal further provision of pure seed will be necessary.

Financial provision.

The present budget provision covers the scheme up till 1918. By utilizing our existing agencies for seed-growing and distribution to the fullest extent, we will be able to complete the distribution of 8,000 maunds of seed in small quantities in the summer of 1918. The distribution of an additional 12,000 maunds will, however, mean going further afield into new districts and the cost of raising additional seed.

A scheme to enable the Department to complete its first distribution in 1919 has been approved by the Bengal Government. This includes the appointment of new District Agricultural Officers, the establishment of three small farms to act as nuclei of seed areas, provision for the purchase of bags, for packing, railway freight, etc. The estimated total cost of the scheme amounts to Rs. 1½ lakhs, but this includes a sum of Rs. 26,000 for jute seed which it is proposed to distribute through the same agency as the paddy seed. The proposal has been approved by the Bengal Government. It is not certain, however, that funds will be available in 1918. The production of pure seed for distribution will be partly effected through existing farms by using all available areas for the purpose, and partly by arrangement with outside growers under the control of the Department.

From the foregoing it appears possible to increase vastly the outturn from the transplanted rice area in Eastern and Northern Bengal by the introduction of the new *Indrasail* variety, the full effects of which would, however, not be felt before the harvest of 1920. If the scheme approved by the Bengal Government is given effect to through financial provision being made in this year's Budget, the maximum possible rate of expansion will have been attained, so long as no new localities are found suitable to the *Indrasail* variety. Extensions to new localities as, for example, the Western Bengal districts, will require funds in proportion to the areas involved.

Increase of production per acre through the extended use of manures.

An extended use of manures such as castor-cake and bonemeal is to be looked for, but such will necessarily be very gradual for years to

come, and no rapid expansion is possible except by free distributions on a wholesale scale, involving an enormous supervising staff and great waste.

Similarly no rapid developments in the adoption of cultural methods leading to increased crop outturns can be expected without a large increase in the district staff. We have practically only one recommendation in this direction, *viz.*, the use of *dhaincha* (*Sesbania aculeata*) as a green manure for transplanted paddy. This is being demonstrated in Western Bengal. Progress however has been slow and will necessarily continue so owing to lack of staff, but any attempt to inflate unduly the numbers of the demonstrating staff without previous preparation is not likely to lead to successful results.

New crops.

Some success has been met with in the introduction of groundnuts on culturable waste lands in the districts of Birbhum and Bankura, but here again rapid expansion cannot be looked for owing to labour difficulties. After several years' work the area under this crop amounts to some hundreds of acres only. No other new food crops have been introduced, nor have we any to recommend.

Suggestions for the increase of areas under food crops at the expense of areas under other crops are all open to serious economic objections. There exists, for example, in Eastern and Northern Bengal a fluctuating area which alternates between jute and rice cultivation, the crop being determined largely by the relative values of rice and jute. The balance between the two crops is rapidly adjusted to meet changing conditions, a decrease in the jute area and a corresponding increase in that under rice following low prices for jute fibre, and *vice versâ*. The controlling factor is therefore relative values and nothing short of measures to adjust the balance in favour of rice would have the slightest effect.

Summary.

The only practical method at hand of rapidly and materially increasing the food products in Bengal appears to be in the increase of the area under the higher-yielding varieties of transplanted paddy, and this can be most readily effected by the distribution on a wide scale of the new Dacca *Indrasail* variety in Eastern and Northern Bengal and in other districts where it may be found superior to existing varieties.

NORMAL AREA UNDER CROPS IN BENGAL.

Food-grains—	
1. Rice—	
(i) Bhadoi or aus—harvested from mid June to mid November	5,031,500
(ii) Aman or winter—harvested from mid November to end of February	16,622,500
(iii) Boro or summer—harvested from 1st March to mid June	370,600
TOTAL	22,024,600
2. Wheat	205,400
3. Barley	140,700
4. Jowar (*A. Sarghum*)	2,400
5. Bajra (*Pennisetum typhoideum*)	6,900
6. Maize	100,200
7. Gram	275,000
8. Other food-grains (including pulses and *maruа*) (*Eleusine coracana*)	1,730,100
TOTAL	24,485,300
Oil-seeds—	
9. Linseed	226,600
10. Til (*Sesamum indicum*)	325,700
11. Rape and mustard	1,352,400
12. Others	65,900
TOTAL	1,970,600
13. Condiments and spices	205,500
Crops grown for sugar—	
14. Sugarcane	256,100
15. Others	129,700
TOTAL	385,800
Fibres—	
16. Cotton	44,600
17. Jute	2,643,800
18. Others	44,500
TOTAL	2,732,900
19. Mulberry	29,700
Drugs and narcotics—	
20. Tea	143,500
21. Tobacco	408,800
22. Cinchona	2,500
23. Indian hemp	1,100
24. Others	900
TOTAL	556,800
25. Fodder crops	140,900
26. Fruits and vegetables (including root crops)	715,200
27. 28. Miscellaneous crops { Food	482,200
27. 28. Miscellaneous crops { Non-food	340,600
Total cropped area during the year	32,045,500

CHAPTER II.

UNITED PROVINCES.

(The Hon'ble Mr. H. R. C. Hailey, C.I.E., I.C.S., *Director of Land Records and Agriculture.*)

It is understood that the scope of this enquiry is limited to such methods as the Department may of itself adopt, and wider measures that might be taken by Government acting through other Departments such as the Irrigation Department are not included. The possible means which suggest themselves for the increase of food production are—

(1) increase of the area under cultivation ;

(2) substitution of food for commercial crops ;

(3) increase in productivity of the soil.

As regards (1) it may be briefly dismissed as a matter in which for the immediate future the Agricultural Department could play little part. The cultivated area in the United Provinces, while it fluctuates with the season, over a series of years shows little change. In the closely populated districts little land of value, outside the village grazing lands, remains uncultivated ; where there are still tracts lying waste problems of unhealthiness of climate and scarcity of cultivators arise. The figures of the past few years, *viz.*, 35,646,036 acres in 1910-11 as compared with 35,633,086 acres in 1915-16, do not point to any progressive increase in cultivation, and expansion will only take place slowly as land is cleared and improved in various ways. Without going further into detail it may be said that old fallow, which *primâ facie* seems to offer possibilities of expansion, is considerable in extent only in the sparsely populated parts of Bundelkhand and Mirzapur. The only suggestion which can be made in this connection is that by the use of tractor ploughs land suitable for wheat growing which is now overrun with *kans* (*Saccharum spontaneum*) could be brought under cultivation. The clearing of this land is generally beyond the power of bullock-driven ploughs.

(2) The proportion of non-food to food crops in these provinces is not high. The largest of the former, *viz.*, cotton, covers 1 to 1½ million acres out of the net cropped area quoted above. The principal non-food crops are cotton, opium and hemp. Opium competes with wheat to a limited extent, but the total area is relatively small and produce is now being used for medicinal purposes. Cotton is a rotation crop with wheat, and after it is taken off the ground in canal districts is usually followed by a catch crop of peas or mixed peas and barley. Hemp is almost invariably followed by a *rabi* food crop. There is nothing therefore to be gained by any attempted substitution of food crops for either.

(3) There remains therefore the question of increasing the output by such measures as are directly within the power of the Agricultural Department.

Undoubtedly the most efficacious would be the provision of water in dry and precarious tracts at present under poor and irregular cultivation, or where the existing class of wells yield so little water that intensive cultivation is impracticable. This has been part of the regular work of the Department since its initiation, and has received considerable impetus by the appointment of an Agricultural Engineer and the introduction of tube wells. Though over a series of years it is possible to point to definite improvement, operations necessarily proceed slowly.

Other measures include the distribution of heavier yielding varieties, improvement of methods of cultivation, introduction of rotation systems which will permit of a larger area of food crops being grown.

Taking first the *kharif* crops, among these rice occupies the principal place. Not a great deal of work has been done on this crop; but certain types have been selected which, if kept pure, promise the best yield for particular varieties. The main obstacle, however, to effecting any improvement in the methods of cultivation is the precariousness of the crop, which, except in case of the early varieties, is dependent on late rains. For the five years prior to 1915 the early withdrawal of the rains from Upper India had been a common feature of the monsoon, and the security of the crop really depends on a fuller utilization of the natural supplies of water within the rice-growing tracts. Until such security is to a greater measure ensured, rice-growing will continue to be regarded much in the nature of a gamble, and the cultivators will be reluctant to make any efforts to improve their method of cultivation. The extreme dependence on seasonal conditions is common to all crops sown on the rains and the most feasible lines of development appear to lie in the encouragement of early sown crops on irrigation and improvement of *do-fasli* (double-cropping) cultivation, particularly in the growing of wheat after maize and *jowar* for fodder. In the last

direction a good deal of work has been done by Mr. Burt and it has been demonstrated that with adequate cultivation and manuring of the *kharif* crop wheat crops of good quality can be produced after *jowar* grown for fodder and maize. Wheat following maize is a common enough rotation, but the poverty of the second crop has passed into a proverb, though it has been clearly shown that a marked improvement could be effected. A more intensive cultivation, however, involves use of better implements and more manures and, as in case of other improvements of methods of cultivation, turns largely on economic factors. The provision of cheap cake to supplement the inadequate supply of manure such as *mohwa* (*Bassia latifolia*) cake for maize would be a step of great importance.

As regards the *rabi* crop, the introduction of heavier-yielding varieties offers best promise of an immediate increase in yield of food crops. In Pusa 12 the Department have undoubtedly a heavier yielder than *deshi*, and it is being put out on as large a scale as possible. Pusa 4 is also of considerable value in more limited areas, and in Cawnpore No. 13 we have a third wheat of considerable promise for certain conditions. About 100,000 acres were under these crops last season (1916-17) and the area will be increased during the coming *rabi*. A fair estimate of the minimum increase would be about two maunds per acre, and this represents some, if not a great, increase to the provincial yield. The increase in years when rain in heavy wind occurs in late February or March is greater. Some of the selected barleys for the eastern districts have proved good yielders and are being put out so far as seed supply available permits. Considering the length of time required for raising the general low standard of yield and the obstacles to be overcome in the way of poverty of the agriculturists, uneconomic holdings, etc., the above, *viz.*, the distribution of heavier-yielding varieties, seems the most important line of advance which can be suggested for an increase in production in the immediate future. This involves a somewhat elaborate organization for the distribution of reliable seed which in itself is a material aid in the same direction. Hand in hand with the organization of seed distribution, a great deal of demonstration work in the direction of general improvement of cultivation is being carried on, including correct and adequate tillage, better methods of irrigation, and, in suitable localities, green-manuring.

The question of compact and properly aligned holdings forms a separate subject for discussion by the Board. It is unnecessary to refer to it here as the limitations which the present small and scattered holdings impose on crop yields are generally recognized.

CHAPTER III.

PUNJAB.

(The Hon'ble Mr. C. A. H. Townsend, B.A., I.C.S., *Director of Agriculture and Industries.*)

In this province by far the most important of the food crops grown is wheat. The latest Season and Crop Report of the province gives the following areas under the different food grains in the year 1916-17 :—

	Acres.
Rice	1,063,598
Jowar	1,493,714
Bajra	3,033,211
Maize	1,270,420
Wheat	9,467,240
Barley	1,153,061
Gram	5,115,944
Sugarcane	414,110

Rightly, therefore, the Agricultural Department has as yet devoted most of its time and attention to wheat among the food grains. The methods adopted for improving the crop are two. The first is by encouraging the growth of varieties yielding more per acre than those they displace. The second is by the introduction of improved methods of cultivation.

As to the first method, two wheats have been found to give from half a maund to three maunds an acre more than local varieties in different tracts of the province. These are Punjab 11 wheat which has shown itself well suited to the great canal colonies, the principal wheat-growing tracts of the province, and Pusa 12 wheat which is becoming deservedly popular in the central submontane districts, such as Hoshiarpur, Jullundur and Gurdaspur. Under Punjab 11 the Agricultural Department had 97,000 acres last year (1916-17): under Pusa 12,10,000 acres. Considerably larger areas are under these wheat this year. The Department will continue to encourage their growth and Government has been asked to sanction a grant of two lakhs of rupees in the coming financial year to enable it to buy large quantities

of pure seed of these varieties at harvest time to sell to cultivators at sowing time.

These wheats are certainly not the "last word" in wheats, even in the tracts in which they are grown, and the efforts at present being made by the botanical and agricultural staff of the province to discover wheats better than them will be continued.

For the south-east of the province the Hansi farm is trying to produce a suitable wheat. The farm has been established too recently to expect results yet: but the matter is receiving constant attention. And for the great wheat-growing tract in the north of the province, as Rawalpindi, Government has sanctioned an experimental farm, to be established at Hasan Abdal as soon as circumstances permit.

The second of the two methods of increasing the outturn, mentioned above, is the introduction of improved methods of cultivation. Briefly these methods are the introduction of furrow-turning ploughs: the use of harrows, particularly for young wheat, but also for breaking up the crust on fallows after any rain: interculturing implements: the use of reaping machines in the canal colonies in years when labour is scarce and dear: and the sowing of crops in lines, particularly maize, to facilitate interculture. Much of the wheat grown in the canal colonies is already sown in lines. All these measures tend to increase the outturn per acre, some more than others, and all receive constant attention. The rise in the price of implements imported from Europe and America on account of the war has however checked their sale: some indeed are unobtainable. And efforts are being made to evolve improved implements which can be made, at inconsiderable expense, by village carpenters and blacksmiths, to replace the expensive imported article.

Simple harrows and sowing drills have thus been made at Lyallpur and are becoming popular. The harrow costs about Rs. 12 to make: it is at present being sold at Rs. 8 to encourage its use and some hundreds have been sold in the short period of less than a year since they were introduced. Work on these lines will continue. Apart from wheat, the better cultivation of maize, as I have just said, receives attention: long-cared Australian *bajra* (spiked millet), which yields considerably more per acre than the ordinary millet, is attaining considerable popularity: groundnuts are being tried in light land and work is in progress on sugarcane and rice.

There remains but little more to say. The terms of the reference—the best means of rapidly increasing the outturn of food crops within the power of the Agricultural Department—to which this is a reply, are

not broad, and the words "rapidly" and "within the power of the Agricultural Department" are important. I will, therefore, only make mention of other proposals or methods which, though eventually undoubtedly increasing the food supply of the province, will either not do so rapidly, or depend, either entirely or to some extent, on agencies other than the Agricultural Department. In the former category falls the practice of green-manuring soils lacking in humus, which the Department advocates; the large schemes of reclamation of alkali and other barren soils, with which the name of the late Mr. Barnes will be ever connected; and proposals to increase well irrigation, whether by putting down pipes in existing wells, or entirely new tube well installations. In the latter fall those large irrigation projects of new canals in the province, particularly the great Sind Sagar project of irrigating the sandy Thal of Mianwali and Muzaffergarh from the Indus, at which the Irrigation Department is working, and minor changes in the practices of the Irrigation Department which the Agricultural Department advocates. These include the remission of the charge for a single watering taken during the summer months, when water is generally abundant, for ploughing purposes even though it be not followed by a crop. This is known as the "Vahn" rate. The more cultivation land gets the better, and the remission of this rate would certainly stimulate cultivation. Other such changes the Agricultural Department would like to see introduced are a charge for a single watering for gram, which would of course be less than the usual charge: this would probably stimulate the growth of gram in canal tracts, and the more this beneficial crop be grown the better: and the other is the gradual introduction of a system of charging for irrigation water by volume instead of, as at present, by crop. This change would certainly tend to economy in the use of water. Not only would the present canal crops be thereby benefited, but water would become available for land which at present produces little or nothing for need of it.

NORTH-WEST FRONTIER PROVINCE.

(W. ROBERTSON BROWN, *Agricultural Officer.*)

I fear I am unable to make any really new or useful suggestions on the best means of rapidly increasing the outturns of food crops in India. The area sown with cereals to a large extent depends on the rainfall, or perhaps more especially on the power of the cultivators to make prompt

use of this. It is rare indeed that sufficient rain to germinate wheat does not fall in September, October, or November, in the North-West Frontier Province or in the Punjab, but the cultivators are hardly ever able to sow more than a small part of the area on this rainfall. At present the large landholders do not farm their own land, and their tenants, unaided, are too poor or hold their land on too unfavourable terms to set machinery to work that would give them full advantage of the rainfall. In my opinion a very large part of India's unirrigated cereal crops will be produced by the aid of up-to-date implements and machinery when the landholders farm more of their own land or take active interest in its cultivation. Meantime it might be pointed out to the landholders that they are failing in their duty to their land at the present time, and that they could hardly subscribe to the Empire's weal in a more useful manner than by increasing the produce of their holdings.

The outturn of wheat often depends on the efficiency of the irrigation canals. For example, the yield of grain drops well over a maund per acre per week in each week that passes after the 5th November which is the optimum sowing date in the North-West Frontier Province. Every year the possible outturn of wheat on irrigated land is reduced by hundreds of thousands of maunds by the inability of the canals to give water just at the right time for sowing. It is of course not possible to give every one water at the most propitious moment, but the need for timely irrigation to ensure the best outturns in the autumn should be borne in mind by every canal officer.

Assuredly the new varieties of wheat, maize, etc., that are now being distributed in the provinces will in time increase the outturn of food crops, but rapid increase in India's production cannot be effected in this manner. I have no hesitation in stating that on most of the land I have seen these past twelve years, without new varieties, without more manure than is now used, and actually at a decreased cost of production, the landholders and cultivators could increase their outturn within twelve months' time by probably 10 per cent. if they would exert themselves; if they would *really cultivate* their land. The apathy of the cultivators, I am afraid, is mostly due to the lack of incentive to do better work, for many of them are hopelessly in debt or hold their land on lease for periods which are so very short that they cannot afford to put work or money on their crops.

I am of opinion that the production of food crops in India can be quickly increased by rousing the interest of the landholders in the matter, and making it plain that this is their first duty to the Empire at present. In passing through the wheat-growing tracts of India, I have lately seen large quantities of agricultural produce lying exposed to the weather

on railway platforms and sidings. No doubt the accumulation of grain is somewhat larger than usual owing to unavoidable congestion of goods traffic, but I am afraid nevertheless that much available grain is annually lost by the lack of suitable storage at the railway stations.

Then I would suggest that an expert entomologist should settle down at Karachi until some method of reducing the awful destruction wrought by the grain pests there has been found and put in operation. In December last (1917) I saw vast numbers of wheat bags outwardly alive with grain pests at the Karachi railway siding.

CHAPTER IV.

CENTRAL PROVINCES.

(D. CLOUSTON, M.A., B.Sc., *Officiating Director of Agriculture.*)

Three separate notes by Mr. R. G. Allan, M.A., Principal, Agricultural College, Nagpur, Mr. D. Clouston, M.A., B.Sc., Deputy Director of Agriculture, Southern and Western Circles, and Mr. G. Evans, M.A., Deputy Director of Agriculture, Northern Circle, Jubbulpore, are given below. The Northern Circle roughly represents the wheat tract of the provinces, the Southern Circle the rice tract, and the Western Circle the *jowar* and cotton tracts.

(*a*)

(R. G. ALLAN, M.A., *Principal, Agricultural College, Nagpur.*)

The only known methods of increasing the outturn of any crop per acre are tillage and drainage, manure and the introduction of more prolific varieties. The Department has been at work on all these for the last few years. Certain forms of tillage are better, certain manurial treatments have been proved and demonstrated, and better yielding types of paddy, wheat, *jowar* and gram are available and are being sown on a limited scale and pushed as far as the limited staff permits. I do not fancy these can be pressed much faster. The first is dependent on cheap iron and an alteration of land holdings to become widely used, the second is affected by the need for fuel and the limited capital at the cultivator's disposal, and the last is going forward as rapidly as is possible. I doubt if the rapid strides effected in a crop like cotton can be repeated in wheat and paddy, and any such development is linked with the growth of the co-operative spirit. Food crops in Berar again have to compete with a highly lucrative cotton equally wanted and only replaceable by grain in the event of heavy subsidies. Paddy can be increased in yield as has been shown at Labhandi by transplanting, manure and irrigation and selection; the increase of output is dependent on the extension of

irrigation. Wheat indeed represents the only dry crop of a food type of which the price is dependent on an external market demand. In every other case they are, I think, subsidiary to fibre or oil-seeds, for both of which the demand is steady and good. I do not look on the rapid increase of outturn of food crops (both per acre and for the country as a whole) as likely to be possible, though a gradual increase will undoubtedly in time be effected by the further expansion and development of the Agricultural Department.

(*b*)

(D. CLOUSTON, M.A., B.Sc., *Deputy Director of Agriculture, Southern and Western Circles.*)

The chief food crops of the Central Provinces are rice, wheat, *jowar*, pulses and sugarcane. The outturn of these could be increased very much by (1) better cultivation, (2) irrigation, (3) introducing more prolific varieties, (4) seed selection, (5) manuring, (6) double-cropping, (7) protecting crops which are damaged by wild animals, and (8) increasing the area under food crops.

(1) *Better cultivation.* Over the greater part of the Central Provinces rice is sown broadcast; $3\frac{1}{4}$ million acres are cultivated in this way in Chhattisgarh alone. Transplantation with "single" seedlings increases the outturn by from 400 to 500 lb. of grain worth from Rs. 12 to Rs. 15 per acre approximately. If it were possible to get even 50 per cent. of the rice area of this division transplanted, the outturn would be increased by at least 300,000 tons of paddy worth approximately two crores of rupees per annum. After 10 years of hard work the Department of Agriculture has only been able to get 40,000 of the 3,250,000 acres transplanted in this division, and I do not anticipate that progress in this direction will be much accelerated in the near future. The better cultivation of the land with improved implements would undoubtedly lead to a big increase in the outturns of all the food crops grown, but with the limited means at their disposal the poorer cultivators who most require our assistance are not able to purchase such implements, unless they are financed by Government. Government might very well do more than it is doing at present in the way of granting *taccavi* to foster the introduction of improvements along these lines. If a substantial sum were placed at the disposal of the Department of Agriculture to be given out for agricultural improvements, much could be done in a comparatively few years in the way of introducing better implements, better seed and better methods of cultivation generally. Hundreds of thousands

of acres in the Central Provinces at present over-run with *kans* grass (*Saccharum spontaneum*) and other troublesome weeds, could be made to produce large outturns of food crops, if properly cultivated. Over a thousand iron ploughs have, within the last 10 years, been sold by the Department in the Western Circle where the cultivators are well-to-do and can afford to purchase such implements.

(2) *Irrigation.* Nearly all the food crops are benefited by irrigation. In the Central Provinces the area commanded by irrigation was till lately very small. It has been increased enormously within the last 12 years as a result of the numerous irrigation works constructed by Government, more especially in the Chhattisgarh and Nagpur Divisions, where there are three very large canal schemes now nearing completion. These three large schemes are, I consider, of such importance for the agricultural development of the tracts commanded by them that a great effort should be made by Government to complete them in the shortest possible time.

(3) *Crop improvement.* With the advent of irrigation facilities the introduction of new varieties of rice in a tract becomes a feasible and desirable proposition. Late heavy-yielding varieties can be grown in place of light-yielding early kinds. Much has been accomplished in this direction under Government tanks in Chhattisgarh within the last three or four years. Large quantities of selected seed of our best late and medium rices have been distributed from Government and private seed farms, and in many of the commanded villages the area under early rice is now very small. The introduction of one of our selected late rices in these newly irrigated tracts raises the acreage yield by from 350 to 400 lb. of grain per acre. Irrigation facilities, moreover, enable the cultivator to transplant these heavier-yielding varieties, in which case the yield is increased by from 700 to 800 lb. per acre as compared with the outturn of early rice sown broadcast. There are already some hundreds of thousands of acres of our selected *Gurmatia* and *Parewa* under cultivation, and the outturn of rice must have been increased thereby by many thousands of tons.

The irrigation of wheat adds on an average from 100 to 200 lb. to the outturn of that crop per acre ; groundnut is benefited to a still greater extent, as it does best on light porous soils. It has been conclusively proved that the latter crop, grown under irrigation, gives yields of over 1,000 lb. per acre on the lateritic (*bhata*) soil of Chhattisgarh which, before it was commanded by Government irrigation works, was regarded as being almost below the margin of cultivation. There is an area of approximately 75,000 acres of this class of soil which will be commanded by two of the large canal schemes already referred to and which could

within the next two or three years be utilized for the production of groundnut and sugarcane.

(4) The outturns of all the food crops are being increased *by introducing more prolific varieties and by seed selection*. It has been proved on the Raipur and Tharsa farms that the best of the wheats introduced give at least 60 lb. of grain per acre more than the varieties grown locally. The three selected *jowars* being distributed in the cotton tract compare still better with the varieties grown locally. The distribution of improved seed is being carried out in the Central Provinces as fast as circumstances will permit.

(5) *Manuring*. The yield of food crops could be very largely increased in a comparatively few years by judicious manuring. I look forward to the time when it will be possible for Government to finance the cultivator who wishes to purchase manures recommended by the Department on a much larger scale than is being done at present. The Co-operative Department will no doubt take up this work also, but until they are in a position to do so Government should, in order to introduce this and other agricultural improvements as soon as possible, give more in the way of *taccavi* to cultivators.

Everything possible should be done to increase the supply of cattle manure available for application to the land by instructing cultivators in better methods of conserving both the dry and liquid portions. The urine-earth system of conserving the urine is one which will, if adopted by all the cultivators of a village, double the value of the manure available in that village. The use both of green manures and of the more concentrated manures such as cakes and artificials should be demonstrated as soon as it has been proved by experiment that any one of them can be applied with profit. In the Central Provinces the use of cake as a cane manure has been introduced by the Department within the last few years, and has become a common practice among canegrowers in the Southern Circle. The new method of green-manuring rice with *san* (*Crotalaria juncea*) raised on the *rabi* area and applied to the rice area before transplanting is one by which the yield can be very largely increased at a very small cost. This new method of manuring, giving as it does a net profit of about Rs. 25 an acre when properly carried out, is a practice which has great future possibilities. To get cultivators to adopt it on a large scale will, however, require much patient demonstration work.

(6) *Double-cropping*. The double-cropping of rice lands is already widely practised in most districts where the soil is suitable for a second crop.

With the extension of irrigation the area that can be profitably double-cropped with pulses and wheat will be increased. At present the area so cropped varies from year to year, being dependent on the vagaries of the late rainfall. Given irrigation facilities, the cultivator will be largely independent of the rainfall. Under the large irrigation works being opened in the Central Provinces, we look forward to a considerable increase taking place in the area double-cropped.

(7) *Destruction of crops by wild animals.* The amount of damage done in the Central Provinces and Berar every year by wild animals to crops like rice, cane, groundnut, *jowar* and wheat is so great that in many villages they can be saved from total destruction only by employing watchers. The need of adopting remedial measures on a large scale is most urgent. Pigs which frequent the jungle and waste areas in the vicinity of villages account for most of the damage done. Their ravages can be checked to some extent by organizing pig-killing clubs, but it will not be possible to save these crops entirely, except by fencing them with patent pig-proof fencing. Good progress was being made in the Southern Circle of the Central Provinces in introducing this type of fence before the war broke out. I anticipate that when the war ends and prices again become normal, the introduction of this fencing will be one of our principal lines of work in some districts, but here again Government will have to be very generous in granting loans to enable cultivators to purchase it.

(8) *Increase in the area under food crops.* The area under food crops could be largely increased within a very few years, should economic conditions demand it. As a result of high prices since the war began, the area under wheat has already increased to a very large extent, and it will, without doubt, continue to increase at the expense of oil-seeds, for which the demand for the present has decreased owing to the difficulty of export. It can be increased very largely, too, in the Central Provinces at the expense of culturable fallow.

The rate at which the various improvements which I have outlined can be incorporated into the ordinary farm practice of the ryot depends upon circumstances which are not always under the control of the Department of Agriculture. At present the Department is handicapped by want of staff. In the lower ranks we require more Kamdars and more Agricultural Assistants: in the higher ranks we need more Divisional Superintendents and more Deputy Directors. Each province should, in my opinion, be divided up into comparatively small agricultural circles with a Deputy Director of Agriculture in charge of each. Each circle should have its own experimental seed and demonstration farms in order to enable the Deputy Director of Agriculture to test different

agricultural practices, to propagate the seed of strains which he has himself selected, and to demonstrate improvements which he desires to introduce. To effect improvements as expeditiously as possible he should give particular attention to the training of Kamdars for demonstration work, and to the practical training of the sons of land-holders on Government farms in agricultural improvements likely to give immediate results. In conclusion, I would add that as agriculture is, and will remain, our greatest industry and the backbone of finance in this country, the improvement thereof should be taken up in dead earnest. Though much has already been done by Government for the development of Indian agriculture and though practical results of very great economic value have already been attained, these I regard as but an earnest of much more brilliant results to follow.

(*c*)

(G. EVANS, M.A., *Deputy Director of Agriculture, Northern Circle.*)

The Northern Circle of the Central Provinces, of which I hold charge, consists of the nine northern districts in the Nerbudda and Jubbulpore Civil Divisions. The area comprises several distinct *rabi* tracts, wheat being the predominant crop averaging 2½ million acres, while there are also considerable areas of *dhan* (paddy) and minor millets, and small but increasing areas of sugarcane.

IMPROVEMENT OF YIELD BY INTRODUCTION OF IMPROVED VARIETIES.

Wheat. In the Nerbudda Division the new wheats No. 13 and No. 85, which are pure line selections, have given increased average yields over *deshi* wheat of more than one maund per acre during the last three years, and are now grown on about 100,000 acres mainly in the Nerbudda Division. The wheat area of this division (excluding Nimar) is roughly 960,000 acres so that if No. 13 *Pissi* can completely displace *deshi* wheat, the grain increase per annum would represent 960,000 maunds or 30,714 tons.

In the Jubbulpore *Bundhwas* area which includes also parts of neighbouring districts, a straight selection, No. 88 now known as *Muriya*, has averaged on a series of field tests an increase of 150 lb. wheat per acre. The last two years (1915-16 and 1916-17) have been marked by absence of rust, and when this disease occurs, as it does about two years out of five, the increase in favour of No. 88 will be still more marked, as it possesses considerable power of rust-resistance. The average increase per acre over a series of nine years may, therefore, be

taken as two maunds, and the area to which it is particularly suited is about 400,000 acres. If this was all sown with No. 88 the annual increased outturn would be 800,000 mds. or 28,571 tons. The Vindhyan plateau comprising 650,000 acres has still to be tackled, but equally good results are promised for the Seoni District with its 275,000 acres of wheat and for the smaller areas irrigated by Government irrigation tanks where selected types are now being introduced.

The area under rice is relatively small, being only 490,000 acres, but good results are promised by substituting the new varieties, *Basmatia* No. 17 and *Dantasar*, which are now being introduced as rapidly as possible. An increased yield over the local *dhan* of at least three maunds per acre is indicated or a total of 52,500 tons on the whole area.

The present rates of propagation and methods employed.—Seed of improved varieties of wheat from the Government farms is disposed of entirely to certified seed farms. These are the home-farms of certain selected *malguzars* (zemindars) who grow the wheat under the direction of the Department, submit to an inspection of their crops and agree to carry out certain rules which ensure that the seed is kept pure. They renew a portion of their seed from the Government farms each year. They have the first call on any new variety raised by the Department, and the Department acts as an agent when required and arranges for the sale of their produce at remunerative prices.

The produce from these certified seed farms is all sold for seed as follows :—

(1) To Co-operative Societies through the agency of the Central Banks.

(2) To private persons who ask for improved seed.

(3) To their tenants on the *sawai bari* system.

The area under certified seed farms alone for the last six years is given below :—

	1911-12	1912-13	1913-14	1914-15	1915-16	1916-17
Area of seed farms in acres	1,985	2,971	4,070	4,721	5,984	6,108

The average outturn of wheat is not more than six times, and if this be taken as a standard it will give some idea as to the amount of seed which has been introduced in this period.

The inspection of the Department stops with the certified seed farms, but Co-operative Seed Societies are also generally supervised so far as the staff has time.

Possibilities of accelerating. This depends mainly on funds and staff. The latter in particular is very deficient. The system described above is also being applied on a smaller scale to the *dhan* and sugarcane crops.

Sanction has recently been obtained to start four more district seed farms of 150 acres each, and these will in due course have attached to them a group of "certified seed farms." Until these are opened, it has been found practically impossible to help several districts, as the demand for seed far exceeds the supply. We are aiming at establishing at least one big Government seed farm for each district, and there is no doubt that in some districts more than one will be required.

Increase by use of artificial fertilizers.

These are not promising with the exception of superphosphate on rice, which is still in the experimental stage but gives promise of good results. Nitrogenous artificials have not paid on the dry wheat crop as the rainfall is too uncertain a factor.

Improved cultural methods.

The iron plough which inverts a furrow and can be drawn by local bullocks undoubtedly increases the yield. The average outturn of wheat of the whole area of the Powarkhera farm has probably been increased by a maund per acre by using the Monsoon plough for the hot weather and early monsoon cultivation, as its use has resulted in a marked decrease in *kans* and other weeds. Steam or motor ploughs have not been tried as yet and, owing to the smallness of the fields and the difficulty of getting them about in the rains, are not likely to be useful.

Harvesting. Much loss at present is caused by harvesting operations. The Nerbudda reaper has proved satisfactory but is too expensive and too complicated for the majority of the agriculturists in these parts. Great loss is caused on the threshing floors annually. Winnowing machines are in great demand and several hundreds have been sold by now, but it has been found impossible to arrange for an adequate supply as the local workshops available are small and very inefficient. It seems likely that a small type of power thresher, preferably worked by a portable oil engine, will prove most satisfactory. Steam threshers will not have an extended use owing to the absence or extreme roughness of country roads.

CHAPTER V.

MADRAS.

(G. A. D. STUART, I.C.S., *Director of Agriculture.*)

I take it that the emphasis is on the word *rapidly*, and consequently, so far as the Madras Presidency is concerned, the only food crop worth consideration in this connection is rice. Being an irrigated crop, the area annually cultivated, some 11 million acres, is fairly constant, and the return from better varieties and better manuring is *certain*. It is the only food crop in Madras in which there is any appreciable foreign trade. The annual outturn must be at least 6 million tons of husked rice, and of this some 140,000 tons are exported annually, mainly to Ceylon.

IMPROVED VARIETIES.

Work on the selection and breeding of improved varieties has been carried out by Mr. F. R. Parnell at the Paddy-Breeding Station at Coimbatore for the last three years, and a beginning has been made with testing the varieties in the district farms. But we have not yet arrived at the stage at which we can put out improved varieties into the districts on a large scale. We have first to test the superiority of the new varieties by careful comparative experiments. And it must be remembered that it is not only a question of gross yield. The variety must be suited to the special conditions of the tract, and in this connection the period of ripening is of great importance. Experience shows that this often alters when a variety is moved from one district to another. Each variety must therefore be specially tested in the tract for which it is designed. Granted a superior strain suitable to the tract, there would be no difficulty about distributing it. There has been a steady demand this year (1917) for the seed of a bulk selection of the main local paddy made at our agricultural station at Manganallur in the Tanjore delta. Seed sufficient to sow some 2,000 acres was sold in the current season. At an average rate of multiplication this would provide seed for 200,000 acres next year. The total area under paddy of all

varieties in the Tanjore delta, including second crop, is about a million acres. To multiply last year's work by five would not be impossible. We should be compelled to concentrate staff and temporarily abandon work in other districts. But the dislocation will be only temporary, as once a really good variety was widely distributed the work would be finished.

To establish a permanent system of distributing improved varieties as they are bred out will take time, but this will be our ultimate aim. It can be done by organizing co-operative seed unions on the lines of those which have recently been started for cotton in Tinnevelly. Once this system has been organized, any new strain of outstanding merit could be put out in three or four years.

The cost of distributing improved seed should be completely covered by the profits. Granted that the variety is worth distributing, the ryot will pay its full value.

MANURES.

The spread of the use of artificial concentrated manures on paddy land is slow. This is mainly due to the fact that although they give a fair return on the capital spent, yet cattle manure will give a much higher return in proportion to the expenditure. The supplies of the latter cannot be increased and so fields go undermanured, because the landlords will not, and the tenants cannot, face the expenditure of using artificials, although the return may be certain. Much could be done, however, if Government were prepared to take legislative powers and act on a large scale to meet a grave emergency. The following scheme has been suggested by Mr. R. C. Wood, Principal, Agricultural College and Research Institute, Coimbatore :—

(*a*) Government to control the export of (1) oil cake, (2) bones, and buy up as much as was required at fixed rates.

The totals exported annually are as follows :—

	Quantity Tons	Value Lakhs
Bones	8,000	4½
Oil cake	58,000	50

This is mainly exported to Ceylon at present where it is used mostly for non-food crops.

The bones to be converted to super as far as the limited quantity of sulphuric acid allowed, and the rest ground to bonemeal, Government taking control of local manure factories.

(*b*) These manures to be supplied at cost price at depôts in a selected rice-growing area, *e.g.*, Periyâr tract in Madura=167,000 acres; value to be recovered along with the land revenue after harvest. There is little doubt that the cultivator would take the manure readily so long as immediate payment was not asked for.

(*c*) The result would be a substantial increase in the total crop of the area, and Government might guarantee to purchase a proportion of the crop at a fixed price in order to provide against any local fall in price due to difficulties of moving the crop. Government would presumably require this grain for export.

Cultural improvements.

The main cultural improvement that has been advocated by the Madras Agricultural Department for rice is a reduction in seed-rate If universally adopted this would result in a saving of at least 100,000 tons of rice per annum, in seed alone, setting aside an increase in production of two or three times this amount. The reform is rapidly spreading, but it is not possible to suggest any method of expediting it to meet an emergency.

CHAPTER VI.

BURMA.

(T. COUPER, M.A., I.C.S., *Director of Agriculture.*)

Present circumstances make it difficult to consider fairly ways and means of increasing food production in Burma. The immediate question is not how to grow more food, but how to sell what has been grown. Enormous stocks of paddy have accumulated for want of tonnage, and the market value has fallen to half of what it ordinarily is at this season. Nothing within the power of the Agricultural Department can counteract the effect of a collapse of price in depressing production.

The crops which are cultivated on a considerable scale and which are not primarily sources of food are cotton, tobacco, rubber and the *dhani* (*Nipa fruticans*) palm. It is improbable that these can be displaced by food crops. The area under cotton responds readily to fluctuations in value but the demand of the cotton trade is commonly said to be likely to remain in excess of the world's outturn; if so, high prices will prevent the substitution of a food crop for cotton. Though there is a large export of tobacco from Burma, the amount imported is larger still: the province consumes more than it produces. Most of the land under rubber and the *dhani* palm is not such as would grow food crops.

The problem has to be regarded from an imperial standpoint: the crops an increase in which is desired are crops that can be exported to Great Britain. The two crops grown on a large scale which are not exported are sesamum and fodder millet. There is little prospect that other foods can be substituted for these: the large import of sesamum seed shows the demand for oil to be greater than the supply, while the requirements of cattle-breeding necessitate the maintenance of a large fodder outturn.

No rapid increase in outturn can be expected from the introduction of improved varieties of seed on the 8,000,000 acres under paddy in Lower Burma. The Department has aimed at raising the income of the cultivator by providing him with pure seed of better quality rather than with

more prolific varieties: its object has been to eliminate red colour and to produce pearly grain of suitable size and shape which will give when milled a large outturn of whole white rice and for which in consequence the mills will pay higher.[1]

The selected variety of paddy which is being distributed in most of the irrigated districts in Upper Burma yields, when grown under supervision on the departmental farm, 20 per cent. more than the unimproved kinds grown by the cultivator. In his hands the increase is less and it will be safe to place it at 10 per cent. The improved variety was grown on 35 acres in 1914, on 350 acres in 1915, on 2,000 acres in 1916, while this year (1917) the area is estimated at 9,000 acres.[2] The district with the largest area under assured irrigation will not grow this paddy; the mills in it work largely for local consumption and the improved variety, though well suited for export to Europe, is not considered locally a good eating rice. At an outside calculation the area on which the improved seed could be cultivated cannot be put at more than 500,000 acres and the increase in food at more than 20,000 tons of rice. To get the seed introduced rapidly into the six districts over which the 500,000 acres are spread three or four seed farms in each district would have to be opened. Once he saw the improved variety grown successfully under local conditions, the cultivator would probably be quick to multiply it.

Increase in feeding value is as important as increased outturn. It has often been asserted that the polishing in the mills reduces the value of rice as food. In the event of shortage it might be necessary to polish less, to sacrifice appearance and to adopt a different method of cooking so as to obtain a more nutritious food.[3]

Except cotton the Department has no other improved varieties ready or nearly ready for distribution. In pulses little assistance is wanted: the rise in the price of the so-called Burma bean has brought about in the past year an increase of 110,000 acres, or 60 per cent., in the area under cultivation. Selection in cotton has so far been made with a view to lint outturn and not to yield of cake or oil.

Chemical analysis has shown that many of the Lower Burma paddy soils are deficient in available plant-food. Experiment on the Hmawbi farm has proved that an increase in yield extending up to 77 per cent. can be obtained by the use in moderate quantity of artificial manures.[1] But at present rates the value of the increase is little, if at all, greater than the cost of the manures. This is true even of bonemeal, which

[1] Reports of the Hmawbi Agricultural Station by Mr. A. McKerral.
[2] Report of the Mandalay Agricultural Station for 1916-17 by Messrs. Thompstone and Sawyer.
[3] The Chemical Composition of Paddy Mill Products by Messrs. Warth and Darabsett.

is crushed locally. If, after the war, paddy rises and manures decline in price, then it may be possible by demonstration to induce the cultivator to increase his outturn by their use. But the price is sure to remain an obstacle to their extended application. Co-operative societies, by advances, and Government, by agricultural loans, cannot make it possible for the cultivator in general to purchase manures, and it would seem that all the Agricultural Department can do, except demonstration, is to bring to the notice of private enterprise the need which exists and the profit to be gained from ministering to it.

The proper conservation of farmyard manure, the application of paddy husk whether burnt or unburnt, the ploughing in of stubble on certain soils in place of burning it, the right quantity of seed in a nursery, the correct spacing of paddy seedlings, the right number to plant together, will all in the long run increase the outturn, once the cultivator has as the result of demonstration grasped their advantages. But no rapid progress can be expected ; in especial, tenants holding on a yearly lease, in whose hands is the cultivation of approximately 3,000,000 acres in Lower Burma, will be slow to avail themselves of methods of manuring which leave the land more fertile than they receive it.

The area annually fallowed in the dry zone of Upper Burma is approximately 3,000,000 acres. The cause is not so much the inadequate amount as the uneven distribution of the rainfall. Though it is only once in four or five years that a fair paddy harvest is reaped and though dry crops are now much more valuable than they were, the cultivator is still in the habit of trying to grow paddy and is forced for want of water to leave much of his land unworked. Another consequence of the uneven rain is the necessity of insuring by growing a multiplicity of crops ; the fall that suits one crop ruins another and so the cultivator occupies a large area and puts down such crops and leaves untilled such soils as the rainfall of the year dictates.

It has been suggested that the Agricultural Department might show the cultivator two ways of reducing the fallow area. One is the conservation of the rain by soil mulching, by growing of hedges to counteract the drying winds, and by the other methods of so-called dry farming. The second is the introduction of steam-ploughing to break up the puddled layers of the paddy fields, followed by demonstration on a large scale of how dry crops may profitably be substituted for paddy. Whatever the merits of these suggestions, time is required for their working, and no rapid increase in food can be hoped for in this way.

Survey of the action within its power seems, therefore, to show that the Department can in Burma do little to bring about rapidly a greater

outturn of food. What it can do appears of little importance in comparison with the stimulus which would be afforded by guarantees of minimum prices, compulsion to grow certain crops, diversion of food exports from foreign countries to Great Britain, and other executive or legislative measures.

Statistics of cultivation in Burma in 1916-17.

	Acres
Occupied area	18,350,000
Fallowed area	3,900,000

Area under—

	Acres		Acres
Paddy	10,600,000	Plantains	120,000
Sesamum	1,215,000	Condiments (chillies, etc.)	100,000
Millets	820,000	Tobacco	80,000
Pulses	650,000	Gram	65,000
Gardens	330,000	Wheat	45,000
Groundnut	260,000	Sugarcane	18,000
Cotton	220,000	*Dhani*	61,000
Maize	170,000	Rubber	59,000

Exports (Inland and Foreign) of certain foodstuffs in 1916-17.

Rice (husked)	41,220,963 cwt.
Pulses	1,642,028 cwt.
Groundnut oil	614,230 gallons
Groundnut cake	545,000 cwt.
Cotton-seed oil	74,000 gallons
Cotton cake	63,000 cwt.
Chillies	2,096,853 lb.

Imports (Inland and Foreign) of certain foodstuffs in 1916-17.

Betelnut	39,288,277 lb.
Sugar excluding molasses, confectionery and saccharin.	301,489 cwt.
Wheat flour	261,861 cwt.
Sesamum seeds	240,517 cwt.
Fruit and vegetables	Rs. 3,310,690 worth.
Tobacco unmanufactured	17,442,832 lb.

Analysis of—

	(i) Polished rice	(ii) Rice meal	(iii)		
Starch	80 per cent.	53½ per cent.	100 lb. husked rice.	55 lb. polished rice.	0·59 lb. nitrogen. 0·14 lb. phosphoric acid.
Proteid	6½ per cent.	11½ per cent.			
Oil	½ per cent.	13½ per cent.		11 lb. meal.	0·22 lb. nitrogen. 0·41 lb. phosphoric acid.
Ash	½ per cent.	9 per cent.			

CHAPTER VII.

BOMBAY.

(The Hon'ble Mr. G. F. Keatinge, C.I.E., I.C.S., *Director of Agriculture.*)

The question is, how can the Agricultural Departments in India take measures to provide for a large outturn of foodstuffs in the immediate future to meet the probable world shortage of foodstuffs.

So far as this Presidency is concerned, the outstanding fact is that a very large area of cotton and oil-seeds is sown every year, and that owing to the very high price of cotton during the past season (1917-18), which continues to the present time, every cultivator will aim at sowing the maximum amount of cotton during the coming season which means a corresponding decrease in food grains. If it is really desired to increase the stock of food grains, the most obviously effective method to do so is to enact immediately that no cultivator shall sow more than a certain proportion of his holding to non-food crops. A second method, which may be adopted in cases where Government control the irrigation facilities, is to issue irrigation water only for food crops. It has been suggested that by issuing superior seed or by taking other methods of direct agricultural improvement some immediate results can be obtained in the direction of increasing the outturns of food grains. I can only say that in this Presidency I do not think that anything material of this kind can be done. The land which is fit for cultivation is already being cultivated as far as the resources of the people will permit, and, while the efforts of the Agricultural Department to secure better cultivation, the use of better seed, and the application of more and better manure, all tend in this direction and are slowly bearing fruit, there is no short cut to success of this kind which we can take. If there were we should have taken it long ago. There are a great number of varieties of *jowar* (*Andropogon Sorghum*), *bajri* (*Pennisetum typhoideum*), rice and wheat sown in the different tracts which are proved by long experience to be suited to those tracts, and we have no superior strain which we can hand out wholesale to the people and which can

be expected to increase the crops. Even if we had such strains, we have not the staff or the organization to do work of this kind on a scale which would produce results in the immediate future, nor could we immediately secure the acceptance of our views by the cultivators concerned. Further we cannot effect any rapid change in the defective organization or the standard of work on the part of the cultivators. I, therefore, think that in this Presidency the only effective steps are those which I mentioned at the beginning, *viz.*, to limit the area of non-food crops on each holding, and to issue irrigation water mainly for food crops.

BIHAR AND ORISSA.

(G. MILNE, M.A., I.C.S., *Director of Agriculture.*)

On receipt of the note recorded by Mr. Milligan, officiating Director of Agriculture, Bengal, regarding a proposed discussion at the Board of Agriculture on the subject of an increase of the outturn of food crops in India in view of demands likely to be occasioned by the continuation of the war, I consulted the Deputy Directors of Agriculture in Bihar and Orissa but received no suggestions of a practical nature, and upon a consideration of the whole situation have decided that the continuance and expansion of the ordinary activities of the Department will best meet the situation. At present these consist, so far as cereals are concerned, in an extension of the area under Pusa wheat, mostly No. 12. In addition groundnut is being introduced on a large scale in Orissa and also in Bhagalpur and Patna Circles. *Indrasail* paddy has also been tried with much success during the past season and there is scope for its introduction on a large scale next year. We have now got to the stage in this province when we are able to think in hundreds of maunds instead of in tens, and I am glad to say that I have received a substantial allotment of Rs. 37,500 in the coming year's (1918-19) budget for the purchase of seed, so that I anticipate very considerable progress in the introduction of improved varieties.

ASSAM.

(J. MCSWINEY, M.A., I.C.S., *Director of Land Records and Agriculture.*)

I have discussed the question at length with Meggitt and McKay and am afraid that in Assam we can do little as a Department. Our

main food crops are rice and tea and with the latter we are not directly concerned. The province in normal years now exports paddy, mainly from the Surma Valley, while the Assam or Brahmaputra Valley still has to import rice to feed the tea garden population. The use of fertilizers or improvements in cultural methods are out of the question here for at least another generation. We are trying to breed pure lines of rice, but, without the help of the Bengal Botanist and in the absence of a Botanist of our own, I am afraid that rapid results are unlikely.

We are growing ourselves about 500 acres of cane which we hope will be made into white sugar. If this experiment succeeds, we hope to see some white sugar factories in the province, but not until machinery is available after the war.

I am writing accordingly to let you know that we can produce no scheme.

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